ward such as Jennings describes, for, according to Rhumbler, the ectoplasm in front is stretched between the *vis a tergo* and the friction against the substratum, is weakened and broken. The upper ectoplasm with a broken front edge can hardly be imagined to pull strongly upon the body behind it.

It is not expedient in this article to go more fully into the facts connected with this familiar phenomenon, which appears to be by no means as simple an action as Rhumbler supposes, when he compares it to the rolling of a rubber tire by hand or to the creeping of a drop of chloroform over a shellac-covered surface. Both of the papers cited, however, deserve the careful attention of every teacher of biology who touches upon the subject of *Amœba* and amœboid motion, although the conclusions of neither writer can be accepted without some modification.

John H. Gerould.

A CULTURE MEDIUM FOR THE ZYGOSPORES OF MUCOR STOLONIFER.

In the first edition of his 'Methods in Plant Histology' Professor Chamberlain speaks of the zygosporic phase of *Mucor* as being 'rarely seen' and requests information of anyone obtaining it. In the recent edition of the same work he refers to the researches of Dr. Blakeslee and then gives directions for making cultures for the zygosporic stage. The method described is rather haphazard and the tone in which it is stated indicates that the results would be doubtful.

During the past three months the present writer has obtained the zygospores so frequently that he now feels confident of being able to secure them at any time within a week. *With proper conditions of moisture and temperature, success is apparently dependent only on the nature of the substratum.* The substratum used is corn muffin bread, made, according to the baker, after the following formula:

Corn meal	16 pounds.
Flour	3 pounds.
Lard	3 pounds.
Salt	½ pound.
Eggs	48
Sweet milk	3 gallons.
Baking powder	18 ounces.

Half a dozen crumbs of this bread of the size of a thimble in as many tumblers, will yield on the average four or five cultures producing zygospores in large numbers in from five to seven days. The atmosphere should be kept saturated, the temperature about 70° F. and darkness is favorable though not necessary.

A series of experiments have been made and others are now under way to determine more exactly the conditions of zygospore formation.

J. I. Hamaker.

College Park, Va.

THE EFFECT OF FERTILIZERS ON THE REACTION OF SOILS.[1]

The effect of fertilizers on the reaction of the soil has interested both the farmer and the scientist for many years, but little experimental work appears to have been done on the problem, however. It is frequently held by farmers that the continued use of fertilizers, particularly of acid phosphates, and also potash salts and ammonium sulphate results in the failure of the red clover crop, a result which is attributed to the acid residues left in the soil by the selective action of plants in removing the essential elements from the salts in which they are applied. While there can be no doubt that certain fertilizing materials, notably ammonium sulphate, will produce an injurious degree of acidity, even changing the reaction of an alkaline soil, the evidence with regard to other fertilizers is not so positive.

Only recently have methods giving definite results been devised by which the total acidity of a soil may be determined. It is possible to determine the acidity of soil within practical limits by the lime-water method,[2] and I have determined the present acidity of a known naturally acid soil which has received different fertilizing treatment, by this method.

Dr. Thorne, of the Ohio Experiment Sta-

[1] Published by permission of the Secretary of Agriculture.

[2] *Jour. Amer. Chem. Soc.*, **26** (1904), 637.

tion, has very kindly sent me samples from a number of the plots of the five years' rotation experiments at Wooster, Ohio, where fertilizing experiments on limed and unlimed land are being conducted. The fertilizing experiments were begun in 1894, while the lime experiments were begun with the corn crop of 1900, each of the five series of plots being given 2,000 pounds per acre of lime (CaO) as it was prepared for corn.

The lime was applied to the plowed ground and harrowed in before planting corn, and the plots were again plowed before the sowing of clover which was sowed in the wheat and timothy a year later.

The reaction of a number of the plots, with other data, is given in the following table:

Plot. No.	Lime Treatment.	Total Fertilizer Applied in Two Rotations.	Acidity in Parts per Million.	
			Limewater Method.	Modified Sodium Chlorid Method.
2	No CaO	640 lbs. acid phosphate.	1,000	224
3	" "	520 lbs. potassium chlorid.	1,100	224
3	CaO	" " " "	Alkaline.	Alkaline.
4	No CaO	No fertilizer.	1,100	308
4	CaO	" "	Alkaline.	—
5	No CaO	960 lbs. sodium nitrate.	800	168
8	" "	640 lbs. acid phosphate, 520 lbs. potassium chlorid.	1,100	308
8	CaO	" " " " " " " "	300	56
12	No CaO	640 lbs. acid phosphate, 520 lbs. potassium chlorid, 1,440 lbs. sodium nitrate.	800	280
17	" "	960 lbs. acid phosphate, 520 lbs. potassium chlorid, 480 lbs. sodium nitrate.	1,100	280
18	" "	32 tons barnyard manure.	1,000	364
19	" "	No fertilizer.	900	364
19	CaO	" "	500	56
24	No CaO / CaO	960 lbs. acid phosphate, 520 lbs. potassium chlorid, 360 lbs. ammonium sulphate.	1,400 / Alkaline.	
29	No CaO	390 lbs. basic slag, 520 lbs. potassium chlorid, 960 lbs. sodium nitrate.	700	102

No difference could be detected in the reaction of water extracts of these soils; all were practically neutral.

For comparison, results by a modification of the sodium chlorid method[3] are also given. The modified method consists of treating 20 grams of the soil with 200 c.c. of $N/5$ neutral sodium chlorid solution in a Jena flask, allowing it to stand over night, filtering, boiling to one half volume and titrating with $N/10$ alkali. The results by this procedure are about double those by the regular sodium chlorid method with this soil.

The results here submitted have considerable interest. Bearing in mind the difficulty of securing representative soil samples, remembering that the method will not give results closer than fifty parts per million, it is still quite evident that several of the fertilizers have had considerable effect on the reaction of the soil. This is most evident on the plots that have received large quantities of sodium nitrate alone, or with other materials. In these cases the natural acidity of the unlimed plots has been materially reduced. Smaller applications of nitrate with full rations of acid phosphate and of muriate of potash have had no apparent effect. Potassium chlorid has not increased the apparent acidity despite the fact that the residue left by the salt is an acid, and the further fact that by double decomposition and absorption such salts give rise to acid reacting salts. Manure too has been without effect. Acid phosphate has, as it should when properly made, slightly reduced acidity. Practically the same story is told by the sodium chlorid results, plots 5 and 29 showing considerable reduction in acidity. An interesting point here is that although enough soda and lime have been applied to these plots to make them alkaline

[3] Bull. No. 73 Bureau of Chemistry, U. S. Dept. of Agr.

by this method the acidity has only been reduced about half. On the other hand, the acidity of plot 24 to which ammonium sulphate has been applied is materially increased, but Dr. Thorne writes me that the red clover grown on this plot is not visibly less than that grown on nearby plots to which nitrogen in linseed meal or dried blood was applied.

No explanation can be offered at this time of the behavior to both methods of plots 8 and 19 limed.

It appears then that while sodium nitrate and basic slag have diminished acidity, no fertilizer or combination of the fertilizers used has measurably increased acidity on this soil except where ammonium sulphate was applied. We can not apply this conclusion, however, to soils of different character. While the acidity due to the residue left by the taking up of plant food may reasonably be supposed to be irrespective of the nature of the soil, the acidity produced by decomposition reactions between the soil components and added salts is not. While in this soil the attack of neutral salt solutions upon what I have elsewhere called 'non-acid silicates' is small, with other soils it is very great, rising to 4,000 parts per million, and this fact must be kept in mind in attempting to measure the changes in soil reaction caused by the use of fertilizers.

F. P. Veitch.

CARBONATED MILK.

In the course of an investigation relating to the chemistry of kumiss made from cows' milk, the question arose as to whether there is any action of carbon dioxide on milk-casein. No action appears to take place when carbon dioxide is passed through milk simply at atmospheric pressure; but, since in kumiss the gas is present under considerable pressure, it was decided to approximate this condition by treating fresh milk with carbon dioxide gas under pressure. Without stating here the detailed results of the work, it was noticed that the milk thus treated did not sour or curdle readily, keeping ten days to two weeks at a temperature of 60° to 70° F., when the pressure used was sixty to seventy pounds. Pasteurized milk keeps still longer. In addition to prolonging its keeping power, milk, when carbonated, makes a very palatable, refreshing beverage. Before the detailed results are published, further work is being done, carbonating the milk at higher pressure and keeping it at different temperatures.

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April 16, 1906.

NOTES ON ORGANIC CHEMISTRY.

PREPARATION OF PURE ETHYL ALCOHOL BY MEANS OF METALLIC CALCIUM.

Metallic calcium having now become a regular article of commerce, several chemists have investigated its properties, in order to discover what advantages are likely to result from its use in chemical reactions. For example, in the chemical laboratory of the Johns Hopkins University, experiments are in progress to determine how far it may be of service in promoting the condensation of ketones with esters (Claisen's reaction).

L. W. Winkler[1] has examined its behavior towards mixtures of alcohol and water. As is well known, there is no special difficulty in removing water from alcohol—say by means of quick lime and copper sulphate—until it is 99.9 per cent. pure, but the elimination of the last 0.1 per cent. of water has been attended, hitherto, with considerable labor. By Winkler's process commercial 'absolute' alcohol, containing usually several per cent. of water, is boiled for a short time with calcium and then distilled from it. About 20 grams of the metal, in the form of turnings, to each liter of alcohol should be used. The product contains only 0.1 per cent. of water, which is removed by another treatment with calcium, in the proportion of 0.5 per cent. of the weight of alcohol. A curious point about the behavior of calcium and alcohol is that, if the latter contains less than 5 per cent. of water, the metal is attacked the more vigorously the *less* water is present, but, on the other hand, ordinary alcohol, containing more than 5 per

[1] *Ber. d. Chem. Ges.*, **38**, 3,612.